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FOREST RESEARCH NOTES

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COMPARATIVE COSTS FOR SLACKLINE, HIGHLEAD AND TRACTOR YARDING

REDWOOD REGION

by
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Tractors have been used for the past 10 years as supplementary yarding equipment in the redwoods, but it was not until about 1933 that they could be considered as serious competitors of the slackline and highlead methods which have been favored by redwood loggers during the last 15 or 20 years. This change in status was the result of marked improvement in the tractors themselves and to an even greater extent to their auxiliary equipment - the yarding arches, single and double hoists and bulldozers, angle dozers and trail builders. By means of this improved equipment the yarding of the largest log that could be handled at the sawmill was made practicable even on steep, rough slopes and the tractor was ready to come into its own.

The success of the tractor in parts of the coastal Douglas fir region of Oregon and Washington, where conditions were not greatly different from those found in much of the redwood region, together with public pressure for less destructive woods practices, provided the necessary incentive and redwood operators, to their credit, undertook to give them a trial. And because of the many advantages inherent in highly flexible equipment, and the possibilities offered through selective logging for greater profits and the saving of unmerchantable trees and reproduction, the California Forest and Range Experiment Station undertook a regional yarding study in cooperation with the redwood operators to compare the efficiency of this new tool with the generally used steam equipment.

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The purpose of the yarding study was:

1. To compare the efficiency and cost of tractor, slackline and highlead yarding; and

2. To determine the effect of log size and certain other factors on yarding costs for the three methods studied.

The field work was begun in 1934 and completed in 1936. Completion was delayed because of the introduction in 1934 of new Diesel equipment which resulted in the virtual obsolescence of the old gasoline tractors. In the course of the study yarding time and cost data were obtained from 3 slackline, 6 highlead and 12 tractor settings, including a total of 8,538 trips with 12,600 logs scaling 24,545,000 ft. B.M.

This report is based on three slackline, three highlead and three tractor settings, all from Humboldt County. They were selected from the settings studied on the basis of similarity of conditions as to volume of stand per acre, and steepness and roughness of topography. Neither the lowest nor highest cost tractor settings were included, and all conditions affecting costs are believed to be at least as favorable on the steam as on the tractor settings. The settings selected were on the operations of three different companies each of which contributed to both steam and tractor data.

Methods

The results are based on:

1. Accurate timing of each activity involved in yarding, such as in and out time, hook and unhook time, all delay items, etc.

2. Careful measurements of diameter and length and determination of cull and gross and net scale for each log.

3. Cost per hour and per minute of each yarding unit for each setting. A tractor arch and drum combination is considered a unit.

The timing and scaling give the basis for determining the volume of logs yarded by each machine. By applying the per minute cost of a yarding unit to the output of that unit the actual cost per M. bd. ft. of log scale was determined.

The data were also analyzed to show the effect of log size, load volume, yarding distance, and slope (for tractor yarding) on yarding cost.

The itemized costs used as the basis of comparison are listed in table 1.

Table 1.- Cost items included in the total yarding cost per hour and per M for tractor, slackline and highlead. Humboldt Scale.

Cost items	Yarding method					
	Tractor[1/]		Slackline[2/]		Highlead[3/]	
	Cost - Dollars		Cost - Dollars		Cost - Dollars	
	Per hour	Per M	Per hour	Per M	Per hour	Per M
1. Labor (including industrial insurance)	2.282	0.542	8.069	0.484	5.558	0.626
2. Fuel (wood and fuel oil for steam. Diesel oil and starting gas for tractors)	0.274	0.041	2.933	0.177	2.582	.310
3. Lubrication (oil and grease)	0.128	0.019	0.333	0.020	0.145	0.016
4. Wire rope	0.915	0.136	4.535	0.271	1.245	0.137
5. Rigging supplies, powder and misc.	0.153	0.023	1.665	0.100	0.727	0.080
6. Maintenance and repairs (including lubrication labor)	1.000	0.150	4.993	0.300	1.318	0.200
7. Uninsured risks (5 percent of average value)	0.221	0.033	0.245	0.015	0.132	0.014
8. Depreciation	1.470	0.221	0.272	0.016	0.146	0.016
9. Interest, taxes and insurance	.375	0.056	0.490	0.029	0.264	0.029
10. Rigging ahead, or road building for tractors	.966	0.110	3.642	0.201	1.868	0.201
Total yarding cost	7.784	1.131	27.177	1.613	14.485	1.629

1/ Average of 3 tractor settings - 1 Diesel and 2 semi-Diesel

2/ Average of 3 slackline settings

3/ Average of 3 highlead settings

Of principal interest are the nearly identical total cost per M feet for the slackline and highlead and the much lower cost for the tractors, nearly 50 cents lower per M feet.

The per hour costs are of little significance for comparison because of the wide variation in output per hour for the different machines.

Effect of Log Size and Yarding Distance on Yarding Cost

Yarding costs per M feet are consistently higher for small logs than for large logs. This is because the scale or board foot content increases faster with size than the cubic content and weight, and because it is easier to handle a given scale in one log if not excessively large, than to handle the same volume in several logs. For example, it is obviously cheaper to handle one log containing 5,000 bd. ft. than 10 logs each containing only 500 bd. ft. although the total scale is the same in both cases. A principal reason for this is that several of the time items - out-time, turning-time (for tractors), and most delay items - bear no relation to log or load-size; and other items - principally hook-and-unhook time - are only slightly affected by log size. Consequently, a large part of the round trip time involved in yarding is not affected by either load or log size and the larger the load or the log (within practicable limits) the smaller the amount of time and cost chargeable to each M feet of scale.

This decrease in cost per M feet with increase in log scale is shown graphically for all three yarding methods in figure 1 and for tractors and slackline in figure 2. Figure 1 is based on an external yarding distance of 1,000 feet and figure 2 of 2,000 feet. High lead yarding costs are not included in figure 2 because this method is not used for yarding much over 1,000 feet.

It should be noted that gross Spaulding scale is used, rather than Humboldt scale, in these charts. Also that rigging ahead, line changing and road building (for tractors) are not included in the costs given. As this combined item is higher for steam yarding than for tractor yarding in practically all cases the inclusion of this additional cost would make the difference in favor of tractor yarding even greater. Various overhead items, and other fixed per-acre costs which would not vary appreciably with the different methods are likewise omitted.

Both figures show that tractor yarding is cheaper than steam logging for all log sizes and for both external yarding distances. The greatest difference in favor of tractor yarding is in the small log sizes, the 500-foot log being nearly 80 cents cheaper per M with the tractor. But it is of interest that the tractor also shows up to advantage with the largest log sizes, because only a few years ago many redwood operators believed that tractors could not handle large logs efficiently. The consistently good showing of the tractor is the more

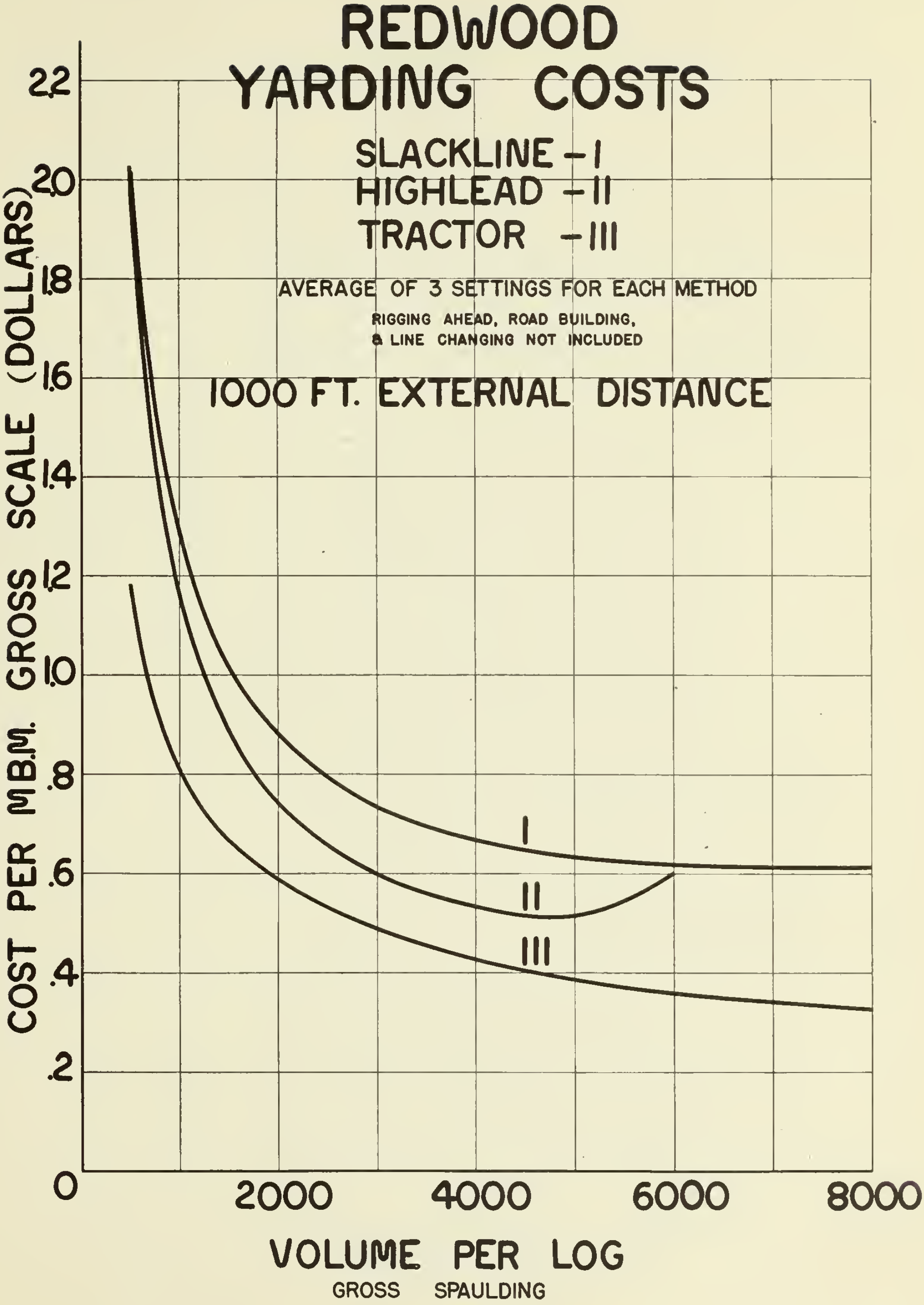
REDWOOD
YARDING COSTS
SLACKLINE - I
HIGHLEAD - II
TRACTOR - III
AVERAGE OF 3 SETTINGS FOR EACH METHOD
RIGGING AHEAD, ROAD BUILDING,
& LINE CHANGING NOT INCLUDED
1000 FT. EXTERNAL DISTANCE
COST PER M.B.M. GROSS SCALE (DOLLARS)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
2000
4000
6000
8000
VOLUME PER LOG
GROSS SPAULDING
I
II
III

Figure 1

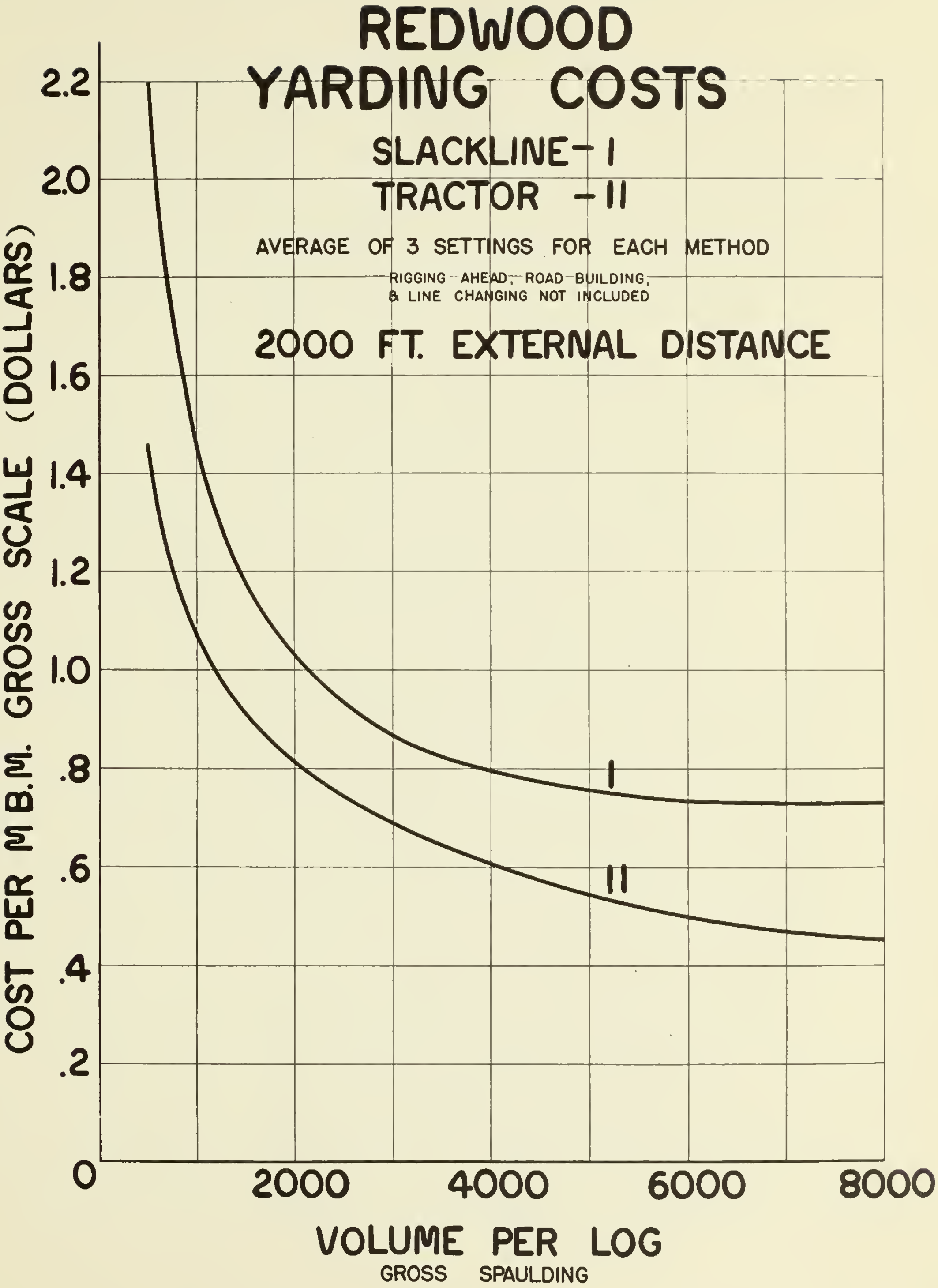
REDWOOD
YARDING COSTS
SLACKLINE - I
TRACTOR - II
AVERAGE OF 3 SETTINGS FOR EACH METHOD
RIGGING AHEAD, ROAD BUILDING,
& LINE CHANGING NOT INCLUDED
2000 FT. EXTERNAL DISTANCE
I
II
COST PER M B.M. GROSS SCALE (DOLLARS)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
2000
4000
6000
8000
VOLUME PER LOG
GROSS SPAULDING

Figure 2

remarkable because it is a relatively new yarding method in the redwood region and still subject to many improvements whereas steam equipment has been used for years and slackline yarding in particular has been developed to a very high point of efficiency.

The difference between tractor and slackline costs with a 2,000-ft. yarding distance is seen to be somewhat smaller than with the 1,000-ft. distance. It should be emphasized, however, that the tractor is much more adaptable, and consequently has a great advantage wherever wide differences in distance are encountered. Both slackline and high lead machines are limited by certain maximum distances beyond which they cannot go and with them the long corner means the additional cost of a "swing". The tractor on the other hand has no such definite limitations and can be used with equal advantage for short and for long hauls up to the point where railroad or truck transportation may compete.

No attempt will be made here to discuss the many other advantages in tractor yarding resulting from the great flexibility of the tractor units. Their superiority in selective logging and the opportunities which they offer for maintaining a steady flow of logs in spite of differences in yarding distance, volume per acre and other conditions; in keeping the various parts of an operation well balanced and in solving many management problems such as filling special orders on short notice, should at least be mentioned.

The material presented in the foregoing is based entirely on summer, or dry weather, logging for both tractor and steam equipment. Tractors are obviously at a disadvantage on wet ground, particularly where clay soils are encountered. This is a serious difficulty for operators wishing to yard entirely with tractors. In some cases a seasonal yarding operation has been found practical and in others attempts are being made to use the tractors through the winter by more careful road location and by frequent changes from road to road and from landing to landing. There are also many possibilities for winter use of tractors with doubledrum for short-distance line yarding and also in combination with Diesel yarders and other less mobile equipment.

In conclusion, it has been demonstrated that tractor yarding is superior to the conventional highlead and slackline yarding under most conditions found in the redwood region, except during the rainy season, and its much wider use is undoubtedly justified. The application of the ingenuity displayed by redwood loggers in the development of steam logging will undoubtedly solve many of the difficulties now encountered in winter tractor logging and make possible the elimination of much of the destruction of unmerchantable trees associated with slackline and to a less extent with highlead yarding.

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